

Some Problems and Corresponding Countermeasures in the Use of Field Oil Pipeline

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Abstract

Field oil pipeline is a large-scale backbone equipment system for the army to carry out emergency long-distance transportation of bulk oil in peacetime and wartime. It is a kind of assembled pipeline system for transporting oil under field conditions. The field oil pipeline consists of pipes, pipe fittings, valves, engines, pumps, measuring instruments and related auxiliary equipment. The length of a field pipeline system is 100 to 150 kilometers. The paper analyzes and discusses the problems in the use of field oil pipeline, such as deployment, inspection and evacuation, and expounds the countermeasures, which can effectively improve the support ability and safety of field oil pipeline.

Keywords

Field oil pipeline, deployment, patrol and repair, evacuation and withdrawal.

1. INTRODUCTION

Field oil pipeline is a large-scale backbone equipment system for the army to carry out emergency long-distance transportation of bulk oil in peacetime and wartime. It is a kind of assembled pipeline system for transporting oil under field conditions. The field oil pipeline consists of pipes, pipe fittings, valves, engines, pumps, measuring instruments and related auxiliary equipment, as shown in Fig. 1. The length of a field pipeline system is 100 to 150 kilometers. Field oil pipeline plays an important role in special tasks such as combat, emergency rescue and earthquake relief.



Fig 1. Field oil pipeline

Fig. 2 shows the IPDS pipeline of US Army in Iraq War. The use of field oil pipeline is not only a highly technical work, but also a work with strict organizational requirements [1]. This work mainly includes pipeline deployment, oil transportation management, evacuation and withdrawal. In the use of field oil pipeline, some problems are easy to appear in the above links. The paper analyzes these problems and puts forward the corresponding countermeasures.

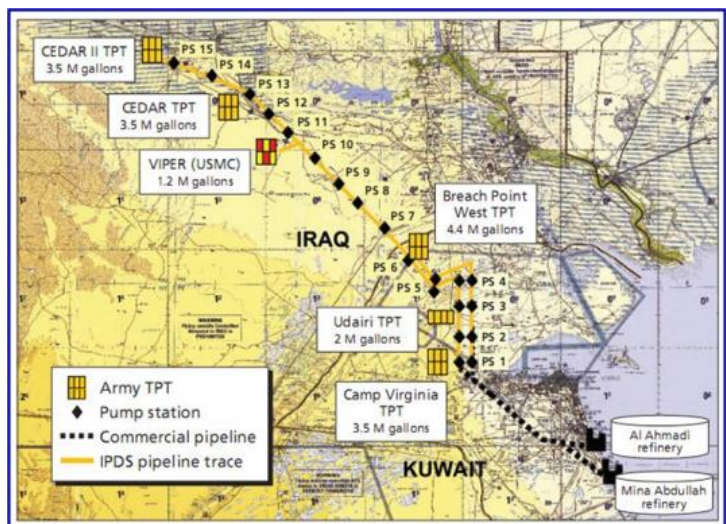


Fig 2. IPDS pipeline of US Army in Iraq War

2. DEPLOYMENT OF FIELD OIL PIPELINE

The field oil pipeline has a wide area and a long distance to be laid. The Fig.3 and Fig.4 show the deployment of field oil pipeline.



Fig 3. Field pipeline crossing river

The sum of the lengths of pipelines laid under favorable conditions is called the reduced length L_z , which is given by equation (1).

$$L_z = L_1k_1k_2 \cdots k_z + L_2k_1k_2 \cdots k_z + \cdots + L_kk_1k_2 \cdots k_z \tag{1}$$

In the equation, L_1, L_2, \dots, L_k represents the actual length of each pipe line under operating conditions, and k_1, k_2, \dots, k_z represents the value of working condition coefficient. Number of manual assembly groups required is given by equation (2).

$$n_k = L_z / N_d \quad (2)$$

In the equation, L_z represents the converted length of manually laid pipeline, and N_d represents the basic quota of pipeline assembly in a team.



Fig 4. Field pipeline through Canyon

Therefore, there are many operation points and a long operation line. The terrain where the field oil pipeline is laid fluctuates, and there are various obstacles to cross. The environment of field oil pipeline is complex and changeable [2]. At present, there are two main problems in the field pipeline deployment. The first problem is that the actual oil transportation process design program is too complicated. The second problem is that there are too many preparatory works before launching, and the overall planning is lack of thoroughness, so it is easy to take one into consideration and lose the other.

In view of the first problem, the following countermeasures are put forward.

2.1. Simplification and Optimization of Pipeline Survey and Process Design Program

When organizing and implementing the pipeline process design, it is necessary to consider the actual situation that the oil demand of the guaranteed object is large and the capacity of the receiving oil depot is small. The process design should not only make the oil depot accommodate, but also make the transportation uninterrupted. In addition, the process design should meet the minimum requirement of pipeline emptying. In other words, the selected flow rate is not the larger the better.

2.2. Application of Low Velocity Pipeline Transportation

First of all, on the premise of meeting the needs of oil transportation guarantee objects, the process design should be carried out according to the economic flow rate as far as possible.

Secondly, in order to minimize the loss of field oil filling, test transportation, shutdown and re transportation, the process design should be carried out according to the longest transportation time as far as possible, so as to extend the transportation time and reduce the situation of artificial pump shutdown.

Finally, it is impossible to achieve satisfactory results only relying on manual or computer software for pipeline survey and design [3]. The design accuracy can be significantly improved by using manual and computer software, which is convenient for oil transportation dispatching management.

In view of the second problem, the following countermeasures are put forward. The first is to carefully raise pipeline equipment and quantify supporting equipment. The second is to Reasonable division of labor and organization. The third is to quantify the preparation before the pipeline is laid.

3. PATROL AND REPAIR OF FIELD OIL PIPELINE

Field oil pipeline inspection and repair is an important part of oil transportation management. Fig.5 shows the inspection and repair of field oil pipeline. Field oil pipeline is a fabricated pipeline, which has complex terrain, long transportation distance and many joints. In the process of oil transportation, oil leakage occurs from time to time.

In addition, the enemy may damage it, and it is easy to cause major accidents, which will cause the whole line to stop transportation and affect the oil supply in wartime. Therefore, in order to improve the safety and support ability of field oil pipeline transportation, pipeline inspection and repair work is of great significance [4]. At present, there are the following main problems in field oil pipeline inspection and repair:



Fig 5. Field oil pipeline inspection and repair

Firstly, rules and regulations for inspection and emergency repair need to be formulated. At present, some army has no official document about patrol and repair of field oil pipeline. There is no unified standard for the division of responsibilities and the plan of line inspection and repair. Secondly, inspection and repair equipment needs to be fully equipped. At present, the pipeline troops of some army have fewer patrol and repair equipment. They cannot meet the needs of line inspection and repair, and need to be equipped with patrol and repair equipment.

4. EVACUATION AND WITHDRAWAL OF FIELD OIL PIPELINE

Emptying is an important process in field oil pipeline operation. Fig.6 shows the evacuation and withdrawal of field oil pipeline. After the completion of the oil transportation task, there will be a large amount of oil in the field oil pipeline, which must be evacuated before withdrawing [5-6]. There are three ways to empty the field oil pipeline, such as water-oil emptying, gas-oil emptying and gravity flow emptying. Evacuation can be carried out in whole line or in sections [7].



Fig 6. Evacuation and withdrawal of field oil pipeline

At present, the evacuation of field oil pipeline has the following main problems.

Firstly, the Evacuation design mainly depends on experience.

Secondly, it is difficult to control the emptying condition due to the lack of detection means. Thirdly, the safety of emptying operation is poor due to incomplete technical measures.

Lastly, the attention paid to the recovery of oil is not enough, and the loss of oil is large.

In view of the above problems, the following countermeasures can be taken. The first is to carry out theoretical and experimental research. The second is to improve the detection technology and means. The third is to Add separation and control devices. The last is to strictly control the discharge of pollutants.

5. CONCLUSIONS

There are many problems in the practical application of the field oil pipeline. These problems are mainly concentrated in the field oil pipeline deployment, inspection and repair, as well as evacuation and withdrawal. In view of the above problems, if the correct countermeasures are taken, the support ability and safety of the field oil pipeline can be effectively improved.

These correct countermeasures put forward in the paper are to simplify and optimize the pipeline survey and process design program, the patrol and repair of the field oil pipeline, the Evacuation and withdrawal of the field oil pipeline, and so on.

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